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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/651,871	08/31/2000	Kevin G. Donohoe	11675.185	4467

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EXAMINER	
VINH, LAN	
ART UNIT	PAPER NUMBER
1765	13

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Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 07-01)

Office Action Summary	Application No.	Applicant(s)
	09/651,871	DONOHOE ET AL.
	Examiner	Art Unit
	Lan Vinh	1765

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *31 January 2003*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *5-8,10-27,29-36 and 38-46* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *5-8,10-27,29-36 and 38-46* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

The changes made to 35 U.S.C. 102(e) by the American Inventors Protection Act of 1999 (AIPA) do not apply to the examination of this application as the application being examined was not (1) filed on or after November 29, 2000, or (2) voluntarily published under 35 U.S.C. 122(b). Therefore, this application is examined under 35 U.S.C. 102(e) prior to the amendment by the AIPA (pre-AIPA 35 U.S.C. 102(e)).

2. Claims 5-8, 11, 12, 15, 16, 17-26, 41, 43-44 are rejected under 35 U.S.C. 102(e) as being anticipated by Koshimizu et al (US 5,980.767)

Koshimizu discloses a method for detecting the end point of a plasma etching process. This method comprises the steps of:

providing an etch chamber 510 and a semiconductor/microelectronic substrate is placed in the chamber (fig. 48)

pulsing into the chamber an CHF/CF based gas (carbon containing polymer gas) by pulse-width modulation (col 38, lines 31-35), fig. 52 of Koshimizu depicts the pulsing (flow rate varies alternately between high and low level) of the CHF gas varies with the flow rate for a plurality of periods of time. Koshimizu also discloses that the pulsing

CHF gas (CHF gas flow rate varies alternately between high and low level of the gas) etches the semiconductor substrate (col 38, lines 60-63) alternately with forming a protective film/deposit 503 on a side surface of the semiconductor substrate (col 38, lines 63-65; fig. 47), the protective film/deposit prevents the sidewall substrate under the protective film/deposit from being etched (col 38, lines 66-67)

Koshimizu also discloses that the ion-generating CF gas/(carbon containing polymer gas) is continuously supplied into the chamber (col 40, lines 62-63 ; fig. 51 of Koshimizu shows that the pulsing of the flow rate/concentration of CHF gas is level between its maximum and minimum at two periods), which reads on the pulsing is applied so that at least one gas does not reach steady state concentration within the etch chamber in the plurality period.

Regarding claim 6, Koshimizu discloses that the etch chamber is a high density plasma chamber (col 19, lines 64-65)

Regarding claim 7, Koshimizu discloses that the substrate comprises a silicon oxide film (col 38, lines 60-61)

Regarding claim 8, fig. 51 shows that the CHF gas flow rate is pulsed so that the gas is at high level in a plurality of period of time that reads on pulsing the gas so that the gas reaches steady state concentration in the chamber. Fig. 51 also shows that the CHF gas flow rate is pulsed so that the gas is at lower level in a plurality of period of time that reads on pulsing the gas so that the gas does not reaches steady state concentration in the chamber.

The limitation of claim 11 has been discussed above.

Regarding claim 12, Koshimizu discloses introducing inert gas into the etch chamber (col 38, lines 27-28)

Regarding claim 15, Koshimizu discloses using a piezoelectric element/valve to control the pulsing of the gas (col 38, lines 42-43)

Regarding claim 16, Koshimizu discloses performs an anisotropic etching to form a trench/contact hole having an aspect ratio of 1 or more (col 38, lines 10-12)

Regarding claim 17, Koshimizu discloses forming a photoresist mask on the substrate (fig. 47)

Regarding claims 18, 24-26, 43, Koshimizu discloses forming an oxide layer and a silicon nitride layer on the substrate (fig. 12)

Regarding claims 19, 44, Koshimizu discloses detecting the end point of the etching process when etching the oxide layer (col 10 lines 17-24)

Regarding claims 20, 21, Koshimizu discloses flowing CF_4/etchant gas into the chamber (col 40, lines 40-41)

Regarding claims 22, 23, Koshimizu discloses flowing the carbon-containing gas comprises carbon and fluorine (polymer)/protective layer forming gas into the chamber to remove a portion of oxide layer (fig. 47)

3. Claims 27, 29-30, 35, 36, 38-39 are rejected under 35 U.S.C. 102(e) as being anticipated by Koshimizu et al (US 5,980.767)

Koshimizu discloses a method for detecting the end point of a oxide plasma etching process. This method comprises the steps of:

forming a patterned semiconductor substrate in a high density plasma chamber, the substrate comprises a silicon layer 60 with a gate stack structure covered by a silicon nitride layer and an oxide layer (col 19, lines 64-65; fig. 12)

flowing CHF_3/hydrofluorcarbon gas into the high density chamber (col 39, lines 54-56)

pulsing the CF_4/fluorocarbons gas(etchant gas) to remove a portion of the oxide layer (col 38, lines 31-34; fig. 47), fig. 52 of Koshimizu depicts the pulsing (flow rate varies alternately between high and low level) of the CF gas varies with the flow rate for a plurality of periods of time. Fig. 51 of Koshimizu shows that the concentration of CF/fluorocarbons gas is higher than CHF_3 gas/polymer forming gas during pulsing, which reads on the second gas is at least intermittently at a higher concentration than the polymer forming gas.

Since Koshimizu discloses flowing 50 sccm of CHF_3/hydrofluorcarbon into the chamber (col 15, lines 51-52) and fig. 51 of Koshimizu shows that CHF_3 gas is pulsed at its high flow rate value (50 sccm) and low flow rate value (half of the high flow rate value) at some periods of time, Koshimizu's teaching of flowing pulsed CHF_3 reads on the hydrofluorocarbons gas is pulsed in a range from about 0 sccm to about 25 sccm. Koshimizu also discloses that it is possible to extract one of the gas (CF_4) during pulsing of CHF_3 and CF_4 (col 41, lines 21-27), which reads on the CHF_3/hydrofluorcarbon is intermittently/pulsed at a higher concentration than the fluorocarbon gas.

etching/removing the silicon oxide film with plasma generated by CHF_3/hydrofluorcarbon gas (col 16, lines 38-46)

the CF (polymer forming gas) gas forms a protective film/layer (col 38, lines 31-32). Koshimizu also discloses pulsing the CHF_3/hydrofluorcarbon and CF_4/fluorocarbons (fig. 52) to form concentration of plasma in cylclical shape in the chamber (fig. 57A)

The limitation of claim 29 has been discussed above

Regarding claim 30, Koshimizu discloses using a piezoelectric element/valve to control the pulsing of the gas (col 38, lines 42-43)

Regarding claims 36, 38, Koshimizu discloses flowing oxygen/gas that modifies the deposition of protective film into the chamber (col 10, lines 19-20), adding CO gas to the process gas to improve etching selectivity (col 34, lines 40-42)

4. Claims 45-46 are rejected under 35 U.S.C. 102(e) as being anticipated by Koshimizu et al (US 5,980.767)

Koshimizu discloses a method for detecting the end point of a plasma etching process. This method comprises the steps of:

providing an etch chamber 510 and a semiconductor/microelectronic substrate is placed in the chamber (fig. 48)

introducing CF_4 gas into the chamber for etching an object and forming a protection film thereon, providing the CF_4 gas at an uniform flow rate to etch a trench in the object/semiconductor substrate (col 34, lines 32-37, fig.51), which reads on providing at one gas capable of both etching the microelectronics substrate and forming a deposit on a side surface of the substrate, the use of the gas at a uniform flow rate provides a desired etch profile at a flow rate selected within the first process window

pulsing into the chamber an CHF/CF based gas (carbon containing polymer gas) by pulse-width modulation (col 38, lines 31-35), fig. 52 of Koshimizu depicts the pulsing (flow rate varies alternately between high and low level) of the CHF gas varies with the flow rate for a plurality of periods of time. Koshimizu also discloses that the pulsing CHF gas (CHF gas flow rate varies alternately between high and low level of the gas) etches the semiconductor substrate (col 38, lines 60-63) alternately with forming a protective film/deposit 503 on a side surface of the semiconductor substrate (col 38, lines 63-65; fig. 47), the protective film/deposit prevents the sidewall substrate under the protective film/deposit from being etched (col 38, lines 66-67). Fig. 52 shows that the flow rate of the CF gas is pulsed between high value /second process window and low value/first process window during the step of etching the trench, which reads on the pulsing enables the selection of flow rates from within a second process window that is larger than the first process windown while still providing the desired etch profile in the substrate.

Regarding claim 46, Koshimizu also discloses that the ion-generating CF gas/(carbon containing polymer gas) is continuously supplied into the chamber (col 40, lines 62-63 ; fig. 51 of Koshimizu shows that the pulsing of the flow rate/concentration of CHF gas is level between its maximum and minimum at two periods), which reads on the pulsing is applied so that at least one gas does not reach steady state concentration within the etch chamber in the plurality period.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. Claims 10, 13, 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Koshimizu et al (US 5,980,767) in view of Corn et al (US 4,585,516)

Koshimizu method has been described above in paragraph 2. Unlike the instant claimed inventions as per claims 10, 13, Koshimizu does not disclose the specific duty cycle of the pulsing, flow rate of the gas.

However, Corn, in a plasma etching method, teaches that duty cycle, gas flow rate are variables that affect etch rate (col 4, lines 15-19)

Hence, one skilled in the art would have found it obvious to modify Koshimizu method by adjusting/vary the duty cycle and flow rate in view of Corn teaching because Corn teaches that one can obtain both high etch rate and good uniformity by varying duty cycle and the flow of the gas (col 4, lines 14-16)

Regarding claim 14, Fig. 52 of Koshimizu shows that the gas flow rate is at high level and low level at the same time duration.

7. Claims 31-34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Koshimizu et al (US 5,980,767) in view of Corn et al (US 4,585,516)

Koshimizu discloses a method for detecting the end point of a oxide plasma etching process. This method comprises the steps of:

forming a patterned photoresist on a semiconductor substrate in a chamber, the substrate comprises a silicon layer 60 with a gate stack structure covered by a silicon nitride layer and an oxide layer (col 19, lines 64-65; fig. 12)

pulsing CHF_3/hydrofluorcarbon gas into the high density chamber (col 38, lines 30-35) to form an oxide/deposit on the semiconductor substrate (fig. 47), fig. 52 of Koshimizu depicts the pulsing (flow rate varies alternately between high and low level) of the CF gas varies with the flow rate for a plurality of periods of time, the CF (polymer forming gas), applying the pulsing at a duty cycle and time varying flow rate (fig. 53)

etching the semiconductor substrate with a CF/fluorocarbons second gas during pulsing (col 38, lines 31-33), the CF/fluorocarbons etching removes a portion of oxide layer and stops on the silicon layer (fig. 47), fig. 51 of Koshimizu shows that the concentration of CF/fluorocarbons gas is higher than CHF_3 gas/first gas during pulsing, which reads on the second gas is at least intermittently at a higher concentration than the first gas.

Unlike the instant claimed inventions as per claims 31, Koshimizu does not disclose the specific duty cycle of the pulsing, flow rate of the gas.

However, Corn, in a plasma etching method, teaches that duty cycle, gas flow rate are variables that affect etch rate (col 4, lines 15-19)

Hence, one skilled in the art would have found it obvious to modify Koshimizu method by adjusting/vary the duty cycle and flow rate in view of Corn teaching because

Corn teaches that one can obtain both high etch rate and good uniformity by varying duty cycle and the flow of the gas (col 4, lines 14-16)

Regarding claims 32, 33, fig. 51 shows that the CHF gas flow rate is pulsed so that the gas is at high level in a plurality of period of time that reads on pulsing the gas so that the gas reaches steady state concentration in the chamber. Fig. 51 also shows that the CHF gas flow rate is pulsed so that the gas is at lower level in a plurality of period of time that reads on pulsing the gas so that the gas does not reaches steady state concentration in the chamber.

Regarding claim 34, Koshimizu discloses flowing inert gas (argon) into the etch chamber (col 38, lines 27-28)

8. Claim 40 is rejected under 35 U.S.C. 103(a) as being unpatentable over Koshimizu et al (US 5,980,767) in view of Ui et al (US 6,164,295)

Koshimizu method has been described above in paragraph 2. Koshimizu differs from the instant claimed invention as per claim 40 by adding CO gas to the process gas to improve/modify etch selectivity instead of adding Cl_2.

However, Ui, in a plasma cleaning method, teaches that gases such as CO and Cl_2 can be added to the process gas to hinder etching (col 7, lines 5-8)

Hence, one skilled in the art would have found it obvious to substitute Koshimizu CO gas with Cl_2 gas in view of Ui teaching because both gases are known diluent to affect etching gas, thus the substitution of one for the other would have produced an expected result.

9. Claim 42 is rejected under 35 U.S.C. 103(a) as being unpatentable over Koshimizu et al (US 5,980,767) in view of Benzing (US 4,786,352)

Koshimizu method has been described above in paragraph 2. Koshimizu differs from the instant claimed invention as per claim 42 by adding an argon gas instead of a nitrogen gas to the chamber.

However, Benzing teaches that inert gases such as argon, nitrogen can be added to the etching chamber containing fluorocarbon gas (col 5, lines 25-28)

Hence, one skilled in the art would have found it obvious to substitute Koshimizu argon inert gas with nitrogen gas in view of Benzing teaching because both argon and nitrogen gases are equivalent inert gas, thus the substitution of one for the other would have produced an expected result.

10. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Bhardwaj et al (6051,503) discloses pulsing an etch gas into the chamber (fig. 6(c))

Response to Arguments

11. Applicant's filed on 1/31/2003 has been fully considered but they are not persuasive.

Applicant's argument that Koshimizu does not teach pulsing is applied so that at least one gas does not reach steady state concentration within said etch chamber in the plurality of period because Koshimizu teaches pulsing wherein the concentration within

the etch chamber reaches steady state at least one in a given plurality of periods.This argument is not found persuasive because although the examiner recognizes that Koshimizu teaches pulsing wherein the concentration within the etch chamber reaches steady state <u>at least one</u> in a given plurality of periods, Koshimizu also teaches pulsing of the flow rate/concentration of CHF gas is level between its maximum and miminum at two periods (fig. 51) , which reads on the pulsing is applied so that at least one gas does not reach steady state concentration within the etch chamber in the two periods. Thus, the examiner asserts that Koshimizu's teaching of pulsing is applied so that at least one gas does not reach steady state concentration within the etch chamber in the two other periods stills reads on pulsing is applied so that at least one gas does not reach steady state concentration within said etch chamber in the plurality of period, as recited in claims 5 and 41.

It is also argued that Koshmizu does not teach "wherein said etchant gas is at least intermittently at a higher concentration than said polymer forming gas because in fig. 50-53, Koshimizu clearly shows that the CF_4 gas is always at an equal or higher concentration than the CHF gas. The examiner disagrees because although fig. 50-53 of Koshimizu clearly shows that the CF_4 gas is always at an equal or higher concentration than the CHF gas, fig. 52 of Koshimizu shows that the flow rate/concentration of CF/fluorocarbons gas is pulsed at high a low value in period of time, which reads on the etchant gas is at least intermittently at a higher concentration than the polymer forming gas.

12. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Conclusion

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lan Vinh whose telephone number is 703 305-6302. The examiner can normally be reached on M-F 8:30-5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin Utech can be reached on 703 308-3836. The fax phone numbers for the organization where this application or proceeding is assigned are 703 872-9310 for regular communications and 703 872-9311 for After Final communications.

LV
April 16, 2003

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